THE GENEVA DOUBLE CURTAIN

FOR VIGOROUS GRAPEVINES

VINE TRAINING AND TRELLIS CONSTRUCTION

NELSON SHAULIS,
E.S. SHEPARDSON, AND T.D. JORDAN

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Cornell University

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Cover Photo and Figure 1 - Overhead view of Geneva Double Curtain trained Concord vines at harvest time in 1965 with leaves removed. GDC training started in Spring of 1963.

Nelson Shaulis is a Professor in the Department of Pomology, New York State Agricultural Experiment Station, Geneva.

E. Stanley Shepardson is a Professor in the Department of Agricultural Engineering, N.Y. State College of Agriculture, Ithaca.

T. D. Jordan is a Cooperative Extension Agent in Jamestown, New York.

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THE GENEVA DOUBLE CURTAIN (GDC) is an improved system of training vigorous vines of certain varieties of grapes used for processing. Research on this system, developed at the New York State Agricultural Experiment Station, Geneva, was initiated in 1960, and grower trials started in 1964.

In this system, vines are trained to a bilateral cordon and are short cane pruned. The elongated trunks are secured to a horizontal cordon wire located 5½-6 feet above the vineyard floor. There are two of these cordon supporting trellis wires, located 4 feet apart, for each row of 9 foot spaced grapes. Vines in the row are *alternated* to the left or right cordon wires to give the double curtain effect. These cordon wires are held in position by wood or metal supports attached to sturdy posts spaced 24 feet apart in the row.

Advantages of changing to the GDC system from the traditional Kniffin training include better fruit and vine maturation, increased yield (from a vigorous vine), and adaptability for mechanical harvesting of fruit. Increased maturation and increased yield result from the better exposure to light of the leaves on the basal half of the shoot. Mechanical harvesting is possible because of the unique positioning of the cordons and canes as shown in Figures 1 and 2. They are positioned in a vertical curtain 2 feet from the trunks and posts of the vineyard row.

Applicability of Geneva Double Curtain Training

Vine vigor

The increase in maturation of fruit and/or yield is obtained most frequently where the vine size is at least 2 to 3 pounds of cane prunings per vine when spaced 6 to 8 feet apart, respectively, in the row. This is an expected response because shading is greatest in high vigor vines and the Geneva Double Curtain is a correction for that shading.

Fig. 2--Overhead view of Concord vines with GDC training in Spring 1965. GDC training started in Spring 1963.

Distance between rows

The mechanical harvester straddles each row as it harvests the fruit from both curtains. It is currently designed to operate on rows spaced at least 8 feet apart. Vines trained to the Geneva Double Curtain can be

managed with available vineyard equipment on rows at least 9 feet apart. Shielding is recommended for wheeled equipment of all widths. For rows 8-8½ feet apart, the spacing of the cordons may have to be reduced to 42 inches, even though this complicates the vine management.

Headland requirements

For mechanical harvesting, the minimum headland width at each end of the vineyard is 25 feet. This width must be free of anchor guy wires or other obstructions.

Vine spacing

The Geneva Double Curtain may well be used on vines whose spacing is 6 or more feet. The proper vine spacing is dependent on the vigor of the vine and the basic objective is to obtain 0.2-0.3 pounds of prunings per foot of curtain. For example, a vine spaced at 8 feet with cane prunings of 3.2 pounds per vine has 0.2 pounds per foot of curtain.

Double trunks

For Geneva Double Curtain training, vines spaced 8 or more feet apart should have double trunks. In fact, double trunks are desirable for all training systems used in New York State vineyards.

Definitions

The terms cordon wire supports, cordons, cordon wires, curtains, trunk training wire, 5 bud fruiting canes, 1 bud renewal spurs, and cordon ties are explained in Figure 3.

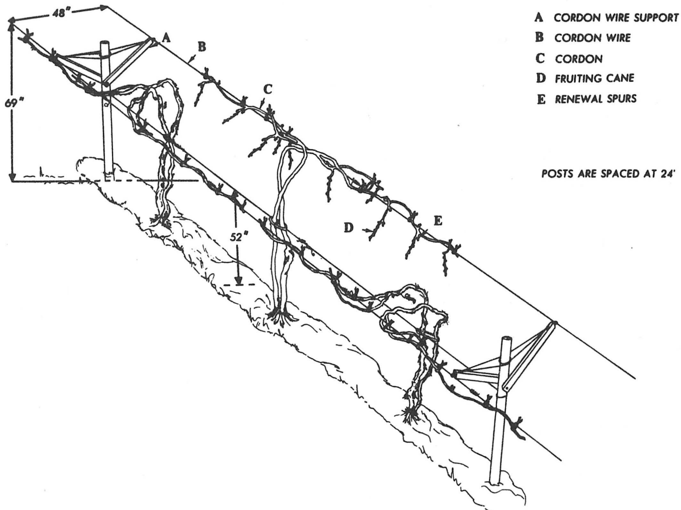


Fig. 3--Diagrammatic sketch of Concord vines trained to GDC system. Spurs and canes are shown only on the middle vine of the post length.

Trellis Construction

End Post Construction

Suggestions for the Geneva Double Curtain trellis end post construction are based on the premise that it provides: (1) stability--so that the cordon wires will not sag unduly due to end post movement; (2) durability--to the extent that the construction will not have to be repaired or replaced for long periods, perhaps 15 to 20 years; (3) economy--in the long run and not necessarily the cheapest installation cost; and (4) convenience. The construction incorporates these characteristics.

Strong end post anchoring systems are needed as shown by failures of conventional systems. The GDC cordon wires are subject to greater crop loads and receive less support from the trellis than with conventional training systems. For mechanical harvesting it is much more important that the cordon wires be kept taut with a minimum of sag between supports. For these reasons the end post must be braced or anchored.

The construction shown in Figure 4 is dependent on the availability of used railroad ties. The minimum length for the end post is 8½ feet. Both this post, and the brace post., should be set 4 feet in the ground with the earth tamped tightly around it. Fall setting is best. The end post should be set at a slight angle so that the

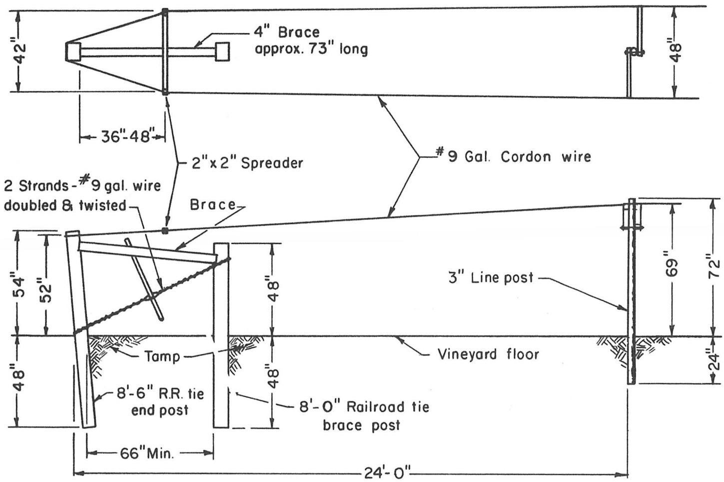


Fig. 4--Suggested end post and brace construction for GDC Trellis System. Cordon wire and brace should be kept high. Success of the construction depends on the deep setting of the wide surface railroad ties.

earth will be compressed ahead of it as it is pulled toward the vertical position when wires are loaded. Wire tightening after frost is out of the ground in the spring is best. Longer posts permit higher attachment for the cordon wire. The 52 inch height shown for the attachment is the minimum desirable for mechanical harvesting. A railroad tie is also chosen for the brace post because of greater stability and lower cost. It should be set at least 5½ feet from the post to prevent disturbing the soil close to the end post. The horizontal brace piece is shown as a 4 inch post, although it is intended that this be selected from the largest of the 3 inch pressure-treated line posts. Two strands of No. 9 galvanized tension wire doubled (to give 4 wire strands) and tightly twisted add strength to the construction. It is desirable to leave the twisting piece locked against the brace.

Advantages of this construction are: (1) Stability and durability, (2) used railroad ties, pressure-treated posts, and galvanized or aluminum coated wire are readily available, and (3) used ties are less expensive than most posts.

There are several alternatives to the suggested end post structure. (1) The stability required is obtained by the large surface of the railroad tie pushing against the soil. Large surfaces can be provided by bigger ties or posts, or by adding cleats to the front edge of the posts. Setting the post in

concrete will also help increase the cross section so long as the concrete does not crack along the side of the post. (2) Substituting round posts with diameters of less than the width of the railroad ties will provide less stability. Five and 6 inch pressure-treated poles will be much less desirable than the railroad ties for end and brace posts. Their use will contribute to earlier failure of the construction. At the same time, costs are considerably higher. (3) A guy wire and anchor can be used for end post stability. The holding resistance of the soil is an unknown quantity and specific recommendations cannot be made.

Several types of anchors might be used--logs, posts, ties, concrete--as well as commercially available screw anchors used by utility companies. The costs of the latter are likely to be high (Fig. 5).

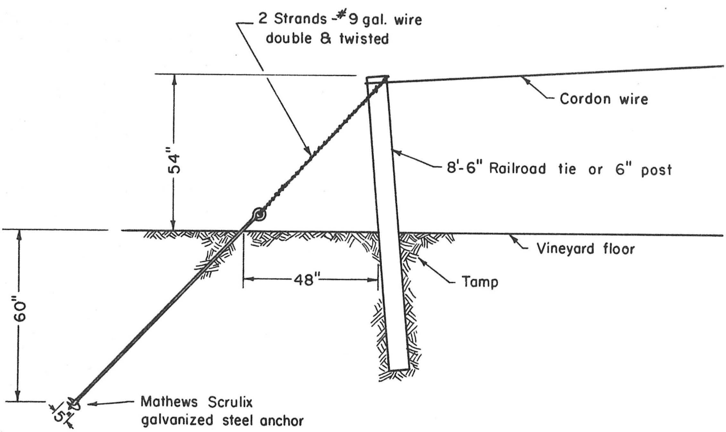


Fig. 5--Screw-in type galvanized steel anchor. Note depth, angle of guy, and size.

The best guide to the use of an anchor system is that a 5 inch screw-in type anchor screwed 5 feet into the ground guyed to a railroad tie (or 5 inch diameter post) at a 45 degree angle (approximately 4 feet from bottom of post) is sufficient. Other equivalent anchors, such as expanding types, can be substituted. Anchors should be installed before the ground freezes in the fall.

Trellis

Experimental field installations of various designs of trellises have indicated that this trellis (Fig. 6) meets the needs the best of any developed to date. Some features included are a pin joint and angle of attachment of the cordon wire support so that it moves freely up, in, and away from the spiked-wheel shaker of the harvester on contact. Placing the wire at the extreme end of the cordon wire support eliminates protruding parts that will entangle with the spiked-wheel of the harvester. The arm must be free to drop back to home position after shaker operation. The trellis can be home-built and installed. A disadvantage of this design is the labor requirement for installation.

Instructions and suggestions for the *INSTALLATION* and *USE* of the Geneva Double Curtain Trellis for 9 foot rows and 69 inch wire height follow (Fig. 6).

Line Posts

(1) Only sound, straight pressure-

treated posts with a minimum diameter of 3 inches should be used. (2) Uniform height makes installation and all other work easier, including mechanical harvesting. (3) Minimum height recommended is 5½ feet. (4) Maximum height recommended is 6 feet. (5) Posts should be firmly set in an upright position.

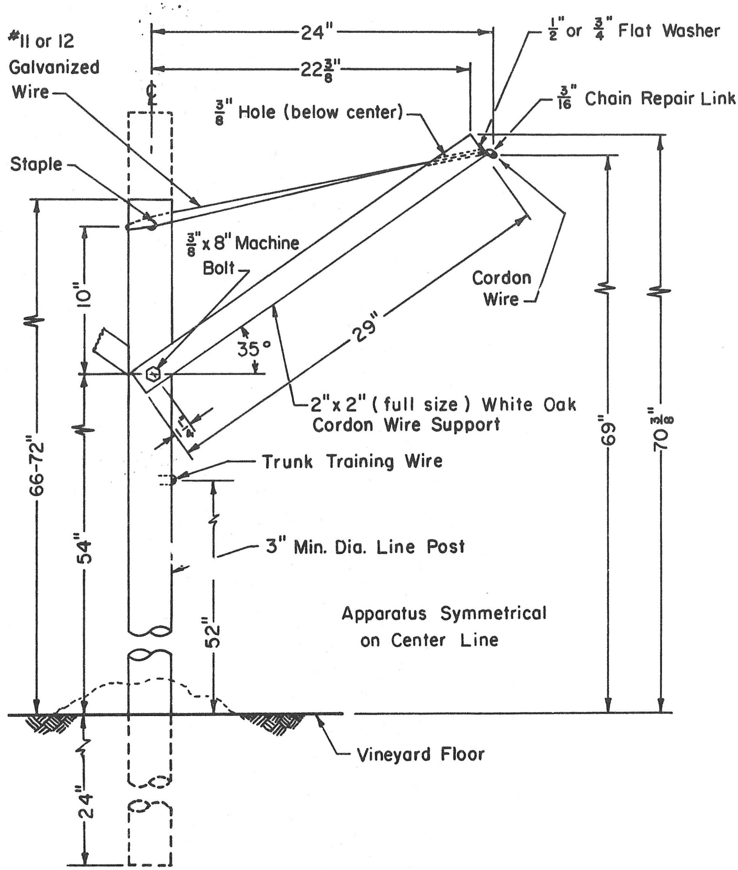


Fig. 6--Details of construction for the Geneva Double Curtain Trellis system. Note: 69 inch cordon wire height, length, and angle of support, and minimum height of post for support wire position.

Cordon wire supports (Fig. 6)

(1) Attachment recommended is 54 inches from vineyard floor. (2) White oak is longer lasting than most other native woods. Douglas fir and hickory are possibilities also. Pressure-treated yellow pine and red oak are satisfactory if treatment is done after supports are made.

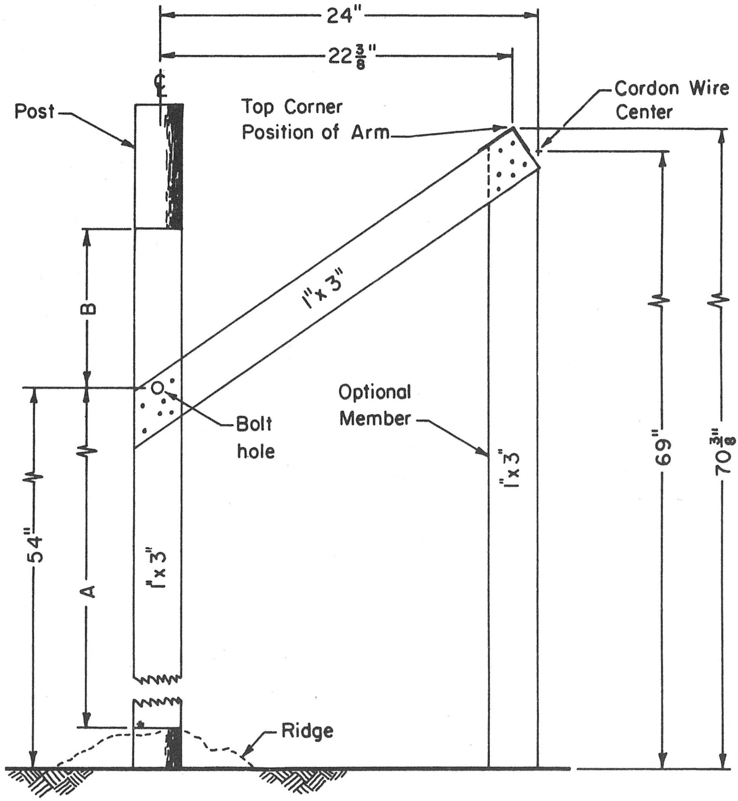
Support wire (post to support)

(1) Can be #11 or #12 galvanized. (2) Strongest design is with wire running horizontally from support to post. *Note: Sketch shows wire to post at lowest recommended angle and attachment.* (3) A jig (Fig. 7) will facilitate location of support piece, cordon wire height, and support wire length. Support wire position should be at highest average position allowable with post height in a particular vineyard. (4) Wire should be loosely stapled to the side of the post.

Cordon wire

(1) Height of cordon wire and distance between wires is related. It might be well to install the wire at 69½ inches to 70 inches high with slightly less than a 24 inch offset (by pulling the support wire a little tighter), because some stretch and sag will take place. (A) Offset becomes 24 5/8 inches when wire drops to 68 inches high. (B) Offset becomes 25 1/4 inches when wire drops to 67 inches high. (C) If pulled up to 70 inches high (by tightening support wire), the offset will be narrowed to 23 1/4 inches.

A 2 x 2 inch full dimension rough sawed spreader for the cordon wires may be used near the end post. This keeps the wires spread for the GDC system as near to the end



Note: A. Adjust length to fit on top of average height of ridge in vineyard.

B. Minimum of 10 inches. Should be as high as average height of posts will allow — up to a horizontal position. See # 3, support wire.

Fig. 7--A jig to speed installation of the GDC Trellis.

of the row as possible. The bolt may need to be used in woods that split easily (Fig. 8). A staple in the end will hold the piece on the wire in case one end should slip from the opposite wire.

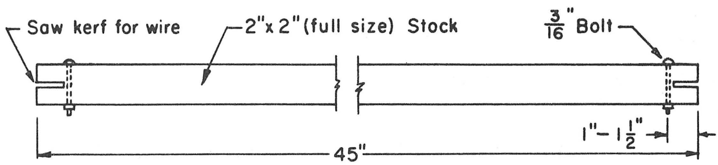


Fig. 8--Details of a spreader for cordon wires. See Fig. 4

Cordon wire spacing described here is 48 inches for rows spaced 9 feet apart. It can be reduced to 42 inches for rows 8 feet apart. Cordon wire spacing and row widths should remain uniform in any one row and preferably throughout the vineyard.

(2) Use #9 galvanized smooth wire.

Trunk training wire

(1) Needed to train trunks to post line when mechanical harvesting is contemplated. (2) Recommended height is 52 inches. (3) Old cordon or salvaged wire can be used (Fig. 6).

Wires

By convention, No. 9 (steel wire gauge) black annealed wire has commonly been used for trellis construction in vineyards. Galvanized or aluminum coated steel wire will last longer. It is recommended that the zinc coating of galvanized wire meet ASTM standards for Class III wire which is 0.8 oz.

per square foot. Class I wire, with 0.3 oz. zinc per square foot will last longer than black wire, but not so long as Class III. The galvanized or aluminum coating will prevent the rapid corrosion and pitting which weakens the wire. The heavier loads imposed on the wires from increased production, the offset support in the GDC trellis system, and the necessity for tighter wires, particularly for mechanical harvesting, dictate the use of the more durable galvanized or aluminum coated wire. It is more economical in the long run. It is possible that new types and specifications for wire will be made by 1967-1968.

Training of Vines

Cordon development and tying

Ultimately the cordon system of a vine with 8 foot spacing should consist of two or three cordons, each 4 to 8 feet in length, along the cordon wire for an over-all length of about 15 feet. These should be secured to the wire by semi-permanent ties.

It is suggested that the canes be wrapped once around the cordon wire to provide support, and tied securely at their ends with wire. Semi-permanent plastic ties should be used along the cordon wire as needed to prevent sagging. Aluminum ties, as designed and used in 1965, were not satisfactory for mechanical harvesting.

GDC Training of New Vineyards

New plantings should generally be train-

ed to umbrella Kniffin or Hudson River umbrella Kniffin through the fourth year. Then it will be possible to determine if the vine vigor is high enough to warrant conversion to GDC.

Where it is certain that the vine vigor will be adequate, GDC training may be started at the time of pruning for the vine's third year in the vineyard. With young-vine training to GDC, overcropping can be serious, either 30 + 10 pruning with flower cluster thinning or 20 + 10 pruning should be practiced until the pruning weight reaches 3 pounds. The second hazard is chafing of the young trunks on the trunk support wire.

Conversion of Mature Vineyards

Any vigorous vine with one or two trunks of 5½ feet height can be converted to Geneva Double Curtain training at one pruning. The first year of conversion can afford gains in fruit maturation and mechanization. An increase in yield can be expected from the second year on. The mature vineyard with vines spaced at 8 feet would, with Geneva Double Curtain training, have the odd-numbered vines trained to one cordon wire and the even-numbered vines trained to the other. This would afford 16 feet of cordon wire per vine.

Consider the conversion of a vine with 2 trunks and 4 pounds of prunings that had umbrella training in 1966. For 1967, the bud number would be 60. The trunks would be about 2 feet apart at the trunk training

wire. To form the cordon system, 3 canes are selected: a 15 to 18 node cane from each trunk; and one shorter cane for the 3 to 4 feet between the trunks. These canes will bear part of the 1967 crop and will become semi-permanent cordons. The remainder of the required 60 buds should, for this conversion year only, be on canes tied along the trunk training wire.

This temporary use of the trunk training wire has the advantages of (a) maintenance of yield in the conversion year and (b) of simplified pruning for the following year. These two factors seem more important than mechanical harvesting of the fruit on the trunk training wire in the conversion year.

Pruning and Control of Crop Size

Balance pruned vines with Geneva Double Curtain training are more fruitful than with other training systems. This fruitfulness is due to a greater number of fruiting shoots from buds retained and to the increase in cluster size. This increased fruitfulness which occurs in the second and subsequent years will lead to serious over-cropping if excessive buds are retained. The controls are: (1) Maintain balanced pruning at 30+10, *including* the buds on renewal spurs in the count; (2) space the fruiting canes over the full length of the cordon wire for that vine; and (3) do not exceed the bud number suggested in Table 1.

As with umbrella training, the bud number for GDC trained Concord vines after the

conversion year is based on the 30 + 10 pruning severity scale. The only difference is that for vines of 5 or more pounds of cane prunings, the maximum bud number is 70 (Table 1) for 16 feet of trellis space. These buds retained for fruiting would be borne on a system of 5 bud canes and 1 bud renewal spurs from the cordons. These 5 bud canes should be spaced evenly. It is desirable that each vine has 10, 1 bud renewal spurs. These renewal spurs should originate as near the cordon as possible and be spaced evenly. Because these 1 bud spurs are highly fruitful, they should be included in the bud number counting (Table 1).

Table 1. Number of buds to retain on each GDC trained Concord vine in second and succeeding years.

Pounds of cane prunings	Buds (including renewal spurs) per vine	No. of 1 bud renewal spurs	No. of 5 bud canes
1	30	10	4
2	40	10	6
3	50	10	8
4	60	10	10
5 and more	70	10	12

Under a combination of very high fruitfulness, of very high vine capacity (as over 5 pounds per vine), and of cool and cloudy weather (as in 1965) it will be necessary to flower cluster thin the crop down to about 8 tons per acre. This flower cluster thinning is necessary to prevent over-cropping which reduces both vine and fruit maturity.

Because of the exceptionally high fruit-

fulness of vines trained to the GDC, particular attention should be given to avoid retaining excessive buds, which lead to overcropping and loss of vine capacity.

Curtain Formation

A trellis which is well anchored, has the best cordon wire support, has the highest quality cordon wires, the best development of cordons, the ideal selection of 5 bud canes and 1 bud renewal spurs and balanced pruning does not have Geneva Double Curtain training until there is shoot positioning to form the two curtains. For Geneva Double Curtain training, shoot positioning must be done each year. *The heart of the whole Geneva Double Curtain development is the shoot and leaf position for adequate exposure,* and without this, the structure is meaningless because it will not increase yield, will not improve maturity, and will be difficult to harvest, even by hand.

The curtain formation is necessary to expose the leaves on the basal portions of the shoot to higher light intensities, and thus to higher temperatures which lead to better development of clusters for the following year, as well as to more rapid maturation of the fruit in the current year. To get this critically important exposure, the long horizontally growing shoots must be put in a vertically downward position so that the basal leaves of nearly all of the shoots will be well exposed. This positioning can only

be done by hand. It can require 20 to 40 hours of work per acre per year and unless one is willing to do this, Geneva Double Curtain training should not be attempted. This shoot positioning can be done during the 4 week period starting immediately after bloom.

Two procedures for shoot positioning are: (1) Make the first shoot positioning early in the 4 week period, and repeat it in 2 to 3 weeks as the shoots again become horizontal. This is recommended! (2) Make the only shoot positioning near the end of the 4 week period. Then, the tendrils will have to be cut because they will have attached shoots to each other and to the trellis structure. This need not be repeated, but is more time consuming than procedure #1.

The only tool necessary for shoot positioning is a pair of grape picking shears for cutting tendrils.

Soil Management of GDC Vineyards

Much of the emphasis during the past decade on having vines of 2-3 pounds of cane prunings per 8 foot space with umbrella or with any Kniffin training should be changed to having 3-4 pounds of vine vigor per 8 foot vine space where the Geneva Double Curtain training is used.

To achieve and maintain this additional vigor on Geneva Double Curtain the following steps need to be considered: (1) Potassium applications will have to be increased for those vineyards where the potassium status of

the vine is near the deficient stage. (2) Weed control may have to be more complete and prolonged through August, especially where vines have less than 3 pounds of cane prunings. (3) Nitrogen applications may have to be substantially increased; 100 pounds of N per acre per year would not be excessive on GDC trained Concords with less than 3 pounds of cane prunings.

In some desirable vineyard sites where vine vigor is very difficult to increase by soil management procedures, the use of vines grafted to a resistant rootstock may be effective.

Costs

During 1965 and 1966 cost data were obtained for mature vineyard conversion to GDC on 32 farms. In 1966, annual operating costs were obtained on 18 farms where conversion to GDC had been accomplished the previous year.

These data show wide variations in cost between farms, due primarily to differences in the number of vineyard posts replaced per acre, and the choice of trellis arms. Some growers replaced no posts while others replaced all the posts. Because of this tremendous variation the cost of post replacement has been excluded from the average cost figures. Thus, each grower should evaluate his own vineyard post requirements when estimating the probable cost of conversion to GDC on his farm.

Keeping in mind the above exclusion, these data indicate that the labor cost was nearly $300.00 per acre for vine and trellis conversion plus growing the crop during the conversion year. The trellising and tying materials cost an additional $175.00 per acre if wooden trellis arms were used, and about $300.00 per acre if metal trellis arms were used. Much of the conversion year cost must, of course, be considered a capital investment.

The cost of labor to grow the crop the year after conversion averaged $175.00 per acre. Here, too, there was considerable variation between farms, particularly in pruning and shoot positioning costs. Current recommendations will likely reduce these. On the basis of evidence to date, other cultural operations, i.e., weed control, insect and disease control, cultivation, and hand harvesting, cost the same for GDC trained vineyards as for other vineyards.

Considering the newness of the system, the relative inexperience of growers with it, and our rapidly expanding knowledge of methods and techniques, it is reasonable to believe that these first cost data are only tentative. It is likely that per acre costs will decrease with increased knowledge and experience.

Research data indicate that the fruit maturity increase, particularly in critical years like 1965, is about 1 per cent soluble solids. This is a splendid response. The

mechanization of harvest will also provide important economic gains. But, with only maintained maturity and hand harvesting, the yield increase of 50 per cent in vigorous vineyards obtained in the 1962-66 experiments can easily repay the costs of installation and operation.

GDC training of *vigorous* vines requires a high input of labor and materials, but it has a higher output of ripe grapes. It is a system which can be abused by careless installation or management. It is new and it is certain that there will be improvements in the future. It is believed, however, that the principle and basic outline presented here afford an adequate guide for New York growers to utilize this development to make their vineyard enterprises even more competitive.